LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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Postoperative Care of Pleural Cavity in Patients after Lobectomy

Master’s Thesis

Thesis Supervisor
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1. Abstract

Research Aim: to analyze and evaluate the postoperative course of patients after lobectomy: normal and complicated course, management, patient outcome and other variables.

Objectives: to assess the effect of various variables on postoperative course and management, to determine the frequency of complications and their dependence on preexisting factors and comorbidities.

Methodology: in this study 48 consecutive patients, who underwent open lobectomy between the years 2011 and 2015, were retrospectively studied using patients files. Various factors and comorbidities were assessed for their influence on postoperative course, such as postoperative days, drain fluid culture results, pharmacotherapy, comorbidities and socio-economical profile of patients. To increase the reliability of the test a randomization of 12 patients from the normal post-operative course was done.

Results: as 6 out of 48 patients developed complications, the rate of complications was determined at 12.5%. Further subdivision of the complications was done in categories, aggravated and complicated dependent on the severity. The mean of hospitalization days for normal, aggravated and complicated courses were 14.5 days, 27 days and 54 days respectively. There was a significant correlation between culture results and postoperative course (p = 0.001), as well as with pharmacotherapy (p = 0.001). The correlation between postoperative course and prolonged hospital stay was calculated using Mann-Whitney test (p =0.009). There was no significant correlation between the diagnosis or comorbidities with postoperative course (p > 0.05).

Conclusions: the complication rate in this study (12.5%) is proven lower than in literature and serves as evidence of an efficient postoperative management by the combined team of specialists. Routine tests and modifications of antibiotic therapy prevented significant complications due to infection in positive culture cases. Early ambulation and chest physiotherapy have prevented DVT and PE complications in all 48 cases. Unfortunately, there will always be unavoidable complications that stem from the progression of the main pathology for which the surgery was indicated.
2. Conflicts of Interest

The author reports no conflicts of interest related to this study.
Clearance Issued by the Ethics Committee

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### 4. Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>CXR</td>
<td>Chest X-Ray</td>
</tr>
<tr>
<td>DVT</td>
<td>Deep Vein Thrombosis</td>
</tr>
<tr>
<td>PE</td>
<td>Pulmonary Embolism</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive Care Unit</td>
</tr>
<tr>
<td>COPD</td>
<td>Chronic Obstructive Pulmonary Disease</td>
</tr>
<tr>
<td>PFT</td>
<td>Pulmonary Function Test</td>
</tr>
<tr>
<td>HTN</td>
<td>Hypertension</td>
</tr>
<tr>
<td>NSAID</td>
<td>Non-Steroidal Anti-Inflammatory Drug</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>IM</td>
<td>Intramuscular</td>
</tr>
<tr>
<td>FEV1</td>
<td>Forced Expiratory Volume in 1 second</td>
</tr>
<tr>
<td>TENS</td>
<td>Transcutaneous Electric Nerve Stimulation</td>
</tr>
<tr>
<td>US</td>
<td>Ultrasound</td>
</tr>
<tr>
<td>VATS</td>
<td>Video Assisted Thoracoscopic Surgery</td>
</tr>
<tr>
<td>IVC</td>
<td>Inferior Vena Cava</td>
</tr>
<tr>
<td>FFP</td>
<td>Fresh Frozen Plasma</td>
</tr>
</tbody>
</table>
5. Terms

**Hospital Stay** – the number of days that patient stayed in hospital after operation.

**Pharmacotherapy** – for this study the term includes combination of medication given to patient as part of postoperative care, including pain relief medication, antibiotics, inhalation therapy and regular medication taken by the patient.

**Postoperative course** – the overall status of the patient during the period after operation until discharge from the hospital or the department.
6. Introduction

The postoperative phase in thoracic surgery is very important because the patients are susceptible to many complications, and improper management in the postoperative stage can increase morbidity, hospital stay and mortality. The incidence of such complications varies from 15% to 37.5%. Hence, a proper postoperative care must be indicated for all thoracic surgery patients on a multidisciplinary level. The multidisciplinary team includes surgeons, radiologists, nurses, rehabilitation physicians and the patients themselves. We measure the complications’ clinical and economic impact using values such as long hospital stay and high dependency unit stay, frequency of ICU admission and number of deaths.

The most effective postoperative management of complications is prevention. It starts with preoperative evaluation and screening of patients to predict such complications and how best to be prepared to avoid or manage them once they happen. There are many patient-dependent factors, of which the main are age, preoperative PFT, cardiovascular co-morbidities, smoking status, and COPD [1]. For planned surgeries, we can ask the patients for cessation of smoking, better management of COPD, and other modifiable factors that can help us avoid complications in the future. Postoperatively, the team can improve the outcome with aggressive therapies for patients who require it and follow guidelines for high risk patients. Even with all the guidelines followed, not all early complications can be prevented or avoided.
7. Aim and Objectives

Aim: to analyze and evaluate the postoperative course of patients after lobectomy, normal and complicated courses, management, patients’ outcome and other variables.

Objectives:

1. To assess and evaluate the postoperative course and management of selected patients.
2. To determine the frequency of postoperative complications and their dependency on comorbidities and pre-existing factors.
3. To determine the influence of socio-economical profile of patients on the postoperative course.
8. Literature Review

Postoperative Care

8.1 Pain Management

Pain management is of greatest importance in the postoperative stage. As most complications can be avoided using chest physiotherapy, without sufficient pain management chest physiotherapy and early patient ambulation is impossible. Pain can be managed by various ways which include epidural catheter perioperatively, paravertebral methods pre- or intraoperatively, or intravenous patient controlled analgesia. Upon withdrawing these agents, patients will require oral analgesics for the duration of the period until they are free of pain. These include paracetamol, NSAIDs and narcotic agents

8.1.1 Epidural analgesia

A catheter is placed with approximation to the dermatomal distribution of the incision site. The combination of a local anesthetic and opioids is the only way to achieve analgesia with minimal blockade of sympathetic system to maintain cough reflex, and without affecting movement and respiratory function after the operation. The most commonly used combination is of fentanyl or diamorphine combined with levobupivacaine [3]. This combination can be administered as an infusion, patient controlled analgesia or both.

Potential problems with this method of analgesia may be failure, technical difficulty, and hypotension. In patient with preoperative low FEV1 this method can reduce the effectiveness of coughing. This method is not offered in case local or systemic infection is present.

8.1.2 Systemic analgesics

Opioids remain the mainstay of postoperative analgesia, and have demonstrated their efficacy in the management of severe pain. The side effects include nausea, vomiting, ileus, biliary spasm, and respiratory depression. Opioids can be administered IM, subcutaneously or IV. Patient-controlled analgesia device is a very efficient way of opioid delivery.

8.1.3 Intrapleural

Intrapleural local anesthesia produces a multi-level intercostal block. However, the effect of analgesia is extremely dependent on patient’s position, infusion volume, and the type of surgery. The effectiveness of this method is less compared to others due to drainage of the anesthetic from the thoracic drain which is placed in the intrapleural cavity. Although occasional successes registered, most clinicians abandon this method from routine usage. [4]
8.1.4 Other techniques

Cryoanalgesia is a method of analgesia by which -600°C probe is applied to an exposed intercostal nerve during the operation, producing an intercostal block that can last up to six months. This allows a decrease in postoperative pain but this method has an incidence of chronic neuralgia that has lead many centers to abandon this technique. This method of pain relief has not proven to be effective on its own and combination with other methods is required [5]. Transcutaneous electric nerve stimulation (TENS) may be useful in mild to moderate pain but is dependent on intensity of stimulation. In studies, TENS was proved to be ineffective when pain is severe and chronic. [6]

8.2 Management of fluid electrolytes

In post-lobectomy patients, reduced amounts of fluids are given to prevent pulmonary insufficiency. Care should be taken not to overhydrate the patient, and oral feeding is encouraged as soon as possible. Administration of maintenance fluid at 1-2ml/kg/h is recommended without exceeding 1.5 l positive fluid balance to lower the risk of post-operative acute lung injury. Silent hypovolemia, impaired oxygen delivery and acute kidney injury should be regarded with caution. Pulmonary insufficiency should always be suspected first in overhydrated patients. If signs of hypo-perfusion appear despite all guidelines mentioned above, inotropic/vasopressors support should be considered. [7]

8.3 Intercostal catheter

Monitoring of drainage and air leak is done by the intercostal catheter. Chest X-ray is used to monitor pleural cavity after the surgery and the efficacy of the drainage of fluids by the intercostal catheter. In cases of expanded lung, no suction is applied. If there is airspace, suction is applied. Removal of drain should be done as soon as possible when drains are no longer functional. Fluid from drains is sent to microbiological analysis for evaluation of sufficient post-operative antibiotic treatment. [8]

8.4 Physiotherapy and early mobilization

Infection, inability to clear secretions or edema at postoperative day 2 or 3 cause postoperative insufficiency which can be prevented by physiotherapy, bronchodilators, IV fluid restriction and tracheal toilet. Deep breathing, coughing exercises and incentive spirometry are all part of chest physiotherapy. Endotracheal suctioning is used in patients who are unable to clear secretions. Diuretics may be used if necessary, and antibiotics are started with clinical indications without waiting for radiological confirmation. Early ambulation and physiotherapy reduces complications like pneumonia, atelectasis, empyema and DVT. Aspiration must be prevented as it may cause multiorgan dysfunction and sepsis. [9] - [12]
8.5 Deep Vein thrombosis prophylaxis

Prophylaxis must be started on admission. If there are no contraindications, subcutaneous dose of 5000 IU Heparin is administered twice daily and continued postoperatively until discharge. Mechanical precautions like compression stockings are indicated for high risk patients. In case of DVT suspicion, US must be arranged, and patients are put on a treatment dose of Heparin infusion. If necessary, IVC filter must be put. [13,15]

8.6 Complications

8.6.1 Postoperative bleeding

The incidence of postoperative bleeding after thoracic surgery is rare. It occurs in less than 2% of VATS and around 1%-3% of open procedures [15]. Usually postoperative bleeding is caused by technical complication but some co-morbidities may predispose patients for bleeding, such as coagulopathies. Those must be addressed with an administration of proper blood product that is missing like FFP, platelets, cryoprecipitate or factor 7. Monitoring of hemoglobin and hematocrit must be done as part of the postoperative care. A chest tube output of 1000ml in 1 hour necessitates an immediate return to the operation room with correction of coagulopathy. Serial drainage of more than 200 ml also indicates for a re-exploration. Assessing for hemodynamic instability is vital in unstable patients with low chest tube drainage or no signs of active bleeding. Chest X-ray may show radiopacity of operated side with thrombosed chest tube. [16,17]

8.6.2 Prolonged air leak

Prolonged air leak is one of the most common complications of lobectomy surgeries. Majority of postoperative air leaks are alveolar and treatment should be aimed in that aspect, as opposed to bronchopleural fistulas which require often an early surgical intervention. [15] According to the Society of Thoracic Surgeons (STS) database, air leaks are those which prolonged the hospital stay of the patient and without them the patient would have been discharged. Also, according to STS database, a prolonged air leak is one that lasts more than 5 days. These air leaks increase not only hospital stay but also the risk of other complications. According to Sunil’s study, 8% - 26% of patients developed prolonged air leak, median duration was 7 days, and 12% of patients had persistent air leak even after 30 days postoperatively [18]. Varela and colleagues have found that prolonged air leak increase pulmonary morbidity, such as pneumonia, atelectasis, and empyema. They also found that hospital stay was prolonged due to those causes [19].

The most common treatment of air leaks is watchful waiting while continuing pleural drainage with tube thoracostomy. More than 90% of air leaks were stopped within several weeks from operation date using solely this method of management with a rare incidence of empyema development. [18] A Heimlich valve is an outpatient treatment option for patient with small, stable, asymptomatic
pneumothorax on water seal [18,20]. Early intervention and outpatient treatment of PAL improves financial performance and hospital margins for lung surgeries. [21]

Autologous blood patch is another non-surgical method of management in patients with prolonged air leak or spontaneous pneumothorax postoperatively [22] - [24]. The procedure involves the instillation of autologous blood into pleural space through a catheter, thus inducing the visceral pleura to adhere to parietal pleura and closing the air leak effectively. This procedure is relatively painless and has minimal risk for complications.

8.6.3 Injury of surrounding structures

Phrenic nerve injury is a risk in any thoracic surgery but especially in surgeries involving the anterior mediastinum, resection of superior sulcus, or right side mediastinal lymph node excision. Phrenic nerve injury may be temporary or permanent. The symptoms include shortness of breath and exercise intolerance [25]. The main radiological sign is an elevation of the affected side of the diaphragm. The diagnosis is confirmed by US. Unilateral palsy is managed with diaphragmatic plication.

Recurrent laryngeal nerve injury presents with hoarse voice and whispery voice. This injury may be asymptomatic but may cause aspiration, or affect the physiotherapy phase of postoperative care because of ineffective cough. Diagnosis is done by laryngoscopy, adducted or sluggish vocal cord will be visualized. The vocal cord palsy may be temporary or permanent, and this will determine the treatment. Medialization with laryngoplasty is advised to assist in postoperative physiotherapy to avoid aspiration and promote coughing. [25]

8.6.4 Infections

Postoperative infections in thoracic surgery patients include incision wound infection, empyema, and nosocomial pneumonia. Antibiotic prophylaxis must be administered postoperatively to avoid complications. Such complications are responsible for an increase in hospital mortality postoperatively of up to 19%, also increasing hospital stay and cost. The incidence of infectious complications is between 5% and 24%. A study has shown that of the positive cultures acquired, 56% were gram-negative bacteria, 39.3% were gram-positive, and 7.1% were fungi [26]. After culture and antibioticogram these infections must be treated with the proper antibiotic. Despite chest physiotherapy, pain control, early ambulation and antibiotic prophylaxis, pneumonia might develop. Postoperative atelectasis and PAL must be managed aggressively to avoid development into pneumonia and empyema respectively. [26]
9. Research Methodology and Methods

9.1 patient selection and amount

Forty-eight consecutive patients, who underwent open left, right or bilateral lobectomy between the years 2011 – 2015 in the department of thoracic surgery in “Kauno Klinikos” university hospital, were selected for retrospective cohort study evaluating the effects of various factors on the outcome and management of postoperative course after lobectomy.

Each patient was evaluated by gender, age, hospitalization days, postoperative days, days until drain removal, preoperative PFT, pharmacological treatment, postoperative course, drainage culture, comorbidities evaluation and socio-economic factors.

9.2 Outcome variables

Primary outcomes of pharmacotherapy evaluation incudes normal pain management with NSAIDs, prophylactic antibiotics 2 medication according patients’ allergic profile (penicillin + Gentamicin on default), inhalation therapy and infusion therapy, combined with regular current medication for each patient. Modified pharmacotherapy refers to the modification of antibiotics according to culture and sensitivity tests done during postoperative period. Advanced pharmacotherapy refers to the administration of additional medications that in a normal postoperative course would not have been administered.

Outcomes of postoperative course include normal course which refers to the expectant uncomplicated course lasting no longer than 25 postoperative days, in which the patient did not have any complication or needed any additional medications or treatment besides monitoring, drain removal, CXR evaluation, antibiotic modification, or pain management. Aggravated course refers to patients who had complications that prolonged their hospital stay and drain removal. These complications include but not limited to infections (pneumonia, pleuritis, etc.), PAL and injury to surrounding structures. Complicated course refers to those cases in which the patient developed critical condition that required aggressive therapy, secondary surgery, transfer to ICU or the patient died.

Comorbidities are limited to hypertension, hypertension + cardiomyopathy, congestive heart failure and other cardiac diseases, primary or secondary lung tumor, COPD, recurrent pneumonia and other pulmonary diseases.

Diagnosis evaluation is divided into three categories. First – clinic, which refers to the standard course a patient will go through in the health care system, starting at the family doctor office, referral to specialist, referral to hospital to surgical department for consultation and preoperative evaluation and
testing, going through surgery, rehabilitation by specialized team and follow-up by specialist and family
doctor. Second – emergency, refers to the diagnosis that was made in an emergency setting when patient
arrived with to hospital in a critical or life threatening situation related to the pathology that will require
surgery in the future. Diagnosis was done as part of the investigation in the emergency room, and surgical
consultation decided if emergency or planned operation is required. Third – incidental, refers to an
incidental diagnosis of a surgery requiring pathology without primary intention. This means an anomaly
found on a CXR that was done for a chest trauma or a routine check-up. Combining this information
with the Socio-economical profiles of patients that were constructed with consideration to their living
place, diagnosis evaluation, Comorbidities and their management by the patients. A predictive
assessment on the postoperative course was completed.

The effect of all the factors mentioned above was evaluated as to how they affect or predict the
outcome and postoperative course of patients who underwent lobectomy.

9.3 Statistical analysis

The statistical analysis was performed using IBM “SPSS” (Statistical Package for the Social
Science), version 17.0 and Microsoft Excel. For evaluation of variable distributions and groups
correlations the following tests were used: Chi-squared test, Student T-Test, Pearson Test, Kruskal-
Wallis Test and Mann-Whitney Test. A statistical difference between two groups defined as p < 0.05.
10. Results

Forty-eight consecutive patients who underwent lobectomy were chosen for the analysis. The study consisted of 16 females and 32 males, by conventional criteria this difference is not considered statistically significant (p = 0.448), see table 1.

Table 1. Patient gender distribution

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percentage</th>
<th>Significance Level (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>16</td>
<td>67%</td>
<td>Chi-square test 1.607</td>
</tr>
<tr>
<td>Male</td>
<td>32</td>
<td>33%</td>
<td>P = 0.448</td>
</tr>
</tbody>
</table>

The mean age of the forty-eight patients was 63 years, ranging from 38 to 79 years. The mean age of the male and female patients was 62 and 66 years respectively. The mean hospitalization days were 21 days, ranging from 9 to 76 days. The means of postoperative days of normal, aggravated and complicated postoperative courses were 14, 27 and 54 days respectively. And the mean drainage removal day was 11th day postoperatively (see table 2 and 3).

Table 2. Age and primary outcome measures

<table>
<thead>
<tr>
<th></th>
<th>Age (years)</th>
<th>Total Hospitalization Days</th>
<th>Post-operative Days</th>
<th>Drainage Removal Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>63.31</td>
<td>20.92</td>
<td>17.71</td>
<td>11</td>
</tr>
<tr>
<td>Std. Error of Mean</td>
<td>1.41</td>
<td>1.898</td>
<td>1.551</td>
<td>1.033</td>
</tr>
<tr>
<td>Median</td>
<td>64.5</td>
<td>16</td>
<td>14</td>
<td>8.5</td>
</tr>
<tr>
<td>Mode</td>
<td>67</td>
<td>15</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>9.768</td>
<td>13.15</td>
<td>10.743</td>
<td>7.158</td>
</tr>
<tr>
<td>Range</td>
<td>41</td>
<td>67</td>
<td>56</td>
<td>42</td>
</tr>
<tr>
<td>Minimum</td>
<td>38</td>
<td>9</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Maximum</td>
<td>79</td>
<td>76</td>
<td>64</td>
<td>42</td>
</tr>
<tr>
<td>Female Mean</td>
<td>66.19</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Male Mean</td>
<td>61.87</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Of the 48 patients, 42 had normal postoperative course. Overall there were 6 patients who developed complication (12.5%) these complications included: 3 patients with aggravated postoperative course that required prolonged hospital stay and delay in drainage removal; of which 2 with PAL that were sealed spontaneously, and one case of pleuritis that required a modification in pharmacotherapy. Other 3 patients had complicated courses: one patient has had postoperative bronchial fistula requiring two additional surgeries for bronchial stem reconstruction; shortly after the second reconstruction surgery patient’s condition deteriorated and the patient died in reanimation department. The second patient had a late stage lung carcinoma that metastasized to liver and patient was unstable; he had a prolonged stay in postoperative care department for close monitoring before he was moved to thoracic surgery department. Third patient developed kidney insufficiency shortly after lobectomy and required aggressive therapy; the patient underwent emergency dialysis and aggressive postoperative care. Later the patient was transferred to nephrology department after removal of pleural drain and negative cultures, and CXR showed no air-leaks, see table 3. To increase the reliability of the study 12 random patients were chosen from the normal group.

Twelve patients underwent left sided lobectomy, 21 patients underwent right sided lobectomy, and 15 underwent bilateral lobectomy, see table 4. During preoperative period, PFT was performed on 32 patients, 27 showed normal PFT, one patient had 1st degree bronchial obstruction, 3 has 2nd degree bronchial obstruction, and one had lung restriction, see table 5. When evaluating the affect of an irregular PFT result preoperatively on the postoperative course using the Pearson correlation test, no significant statistical correlation was found. The testing was done while comparing separate pathologies (p = 0.611), also when unifying all abnormal PFTs (p = 0.333).

### Table 3. Mean of Postoperative days per Course

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>percent</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>42</td>
<td>87.5%</td>
<td>14.45</td>
<td>3.507</td>
</tr>
<tr>
<td>Normal Randomized</td>
<td>12</td>
<td>-</td>
<td>13.58</td>
<td>20539</td>
</tr>
<tr>
<td>Aggravated</td>
<td>3</td>
<td>6.3%</td>
<td>27.33</td>
<td>12.342</td>
</tr>
<tr>
<td>Complicated</td>
<td>3</td>
<td>6.3%</td>
<td>53.67</td>
<td>15.953</td>
</tr>
</tbody>
</table>

### Table 4. Lobectomy

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>12</td>
<td>25%</td>
</tr>
<tr>
<td>Right</td>
<td>21</td>
<td>43.8%</td>
</tr>
<tr>
<td>Bilateral</td>
<td>15</td>
<td>31.3%</td>
</tr>
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</table>

### Table 5. Pulmonary Function Test

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>27</td>
<td>56.3%</td>
</tr>
<tr>
<td>Bronchial Obstruction I</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>Bronchial Obstruction II</td>
<td>3</td>
<td>6.3%</td>
</tr>
<tr>
<td>Lung Restriction</td>
<td>1</td>
<td>2.1%</td>
</tr>
</tbody>
</table>
Routine drainage fluid analysis yielded positive cultures from 10 patients and negative cultures from 32 patients. The six remaining patients’ cultures could not be assessed. Using Pearson correlation test it was shown that there is statistical significant between culture result and postoperative course (P = 0.001), see table 6.

Postoperative evaluation of pharmacotherapy revealed that 40 patients were treated with normal pharmacotherapy. 7 patients with modified pharmacotherapy changed antibiotics according to sensitivity profile of bacterial culture. One patient was treated with advanced pharmacotherapy due to kidney insufficiency post operatively, later the patient underwent dialysis and was transferred to nephrology department. Using Pearson correlation test, there is statistical significant between Pharmacotherapy and postoperative course (p = 0.001), see table 7.

As expected, the number of postoperative days directly affected by the postoperative course with Mann-Whitney Test (p = 0.009) and Kruskal Wallis Test (Chi-square 11.941 p = 0.003), with the randomization of the normal group of postoperative course (n = 12). While evaluating the diagnosis and its effect on the postoperative course, it was shown that 35 patients were diagnosed through specialist clinics, 5 were diagnosed in emergency departments, and 8 were diagnosed incidentally. Using Pearson correlation test there was no statistical significant correlation between diagnosis and postoperative course (p = 0.93) see table 8.

### Table 6. Culture results and significance

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percent</th>
<th>Significance Level (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10</td>
<td>20.8%</td>
<td>Chi-square test 14.591</td>
</tr>
<tr>
<td>Negative</td>
<td>32</td>
<td>66.7%</td>
<td>P = 0.001</td>
</tr>
<tr>
<td>Missing</td>
<td>6</td>
<td>12.5%</td>
<td>-</td>
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### Table 7. Pharmacotherapy evaluation and significance

<table>
<thead>
<tr>
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<th>Amount</th>
<th>Percent</th>
<th>Significance Level (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>40</td>
<td>83.3%</td>
<td>Chi-square test 31.612</td>
</tr>
<tr>
<td>Modified</td>
<td>7</td>
<td>14.6%</td>
<td>P = 0.001</td>
</tr>
<tr>
<td>Advanced</td>
<td>1</td>
<td>2.1%</td>
<td>-</td>
</tr>
</tbody>
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### Table 8. Diagnosis and statistical significance

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percent</th>
<th>Significance Level (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinic</td>
<td>35</td>
<td>72.9%</td>
<td>chi-square 2.045</td>
</tr>
<tr>
<td>Emergency</td>
<td>5</td>
<td>10.4%</td>
<td>p = 0.93</td>
</tr>
<tr>
<td>Incidental</td>
<td>8</td>
<td>16.7%</td>
<td>-</td>
</tr>
</tbody>
</table>
On evaluation of the effect of comorbidities on postoperative course, cardiac and pulmonary comorbidities were chosen. Cardiac comorbidities were further subdivided into HTN (8 patients), HTN with Cardiomyopathy (11 patients) and other cardiac diseases (2 patients). The pulmonary group was first divided into primary (6 patients), secondary tumor (36 patients) and non-tumor pathology (6 patients), and second was divided into recurrent pneumonia (5 patients), COPD (7 patients) and other pulmonary diseases (5 patients). These groups were chosen as they were most common and had highest expectation of yielding a statistical significance. Although using Pearson correlation Test showed no significant statistical correlation in all three groups (p > 0.05), see table 9.

**Table 9. Comorbidities and significance**

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Percent</th>
<th>Significance Level (p≤0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>8</td>
<td>16.7%</td>
<td>Chi-square test 4.348</td>
</tr>
<tr>
<td>HTN&amp;Cardiomyopathy</td>
<td>11</td>
<td>22.9%</td>
<td>P = 0.361</td>
</tr>
<tr>
<td>Other Cardiac diseases</td>
<td>2</td>
<td>4.2%</td>
<td></td>
</tr>
<tr>
<td>Non-Tumor pathology</td>
<td>6</td>
<td>12.5%</td>
<td>Chi-square test 2.921</td>
</tr>
<tr>
<td>Primary Tumor</td>
<td>36</td>
<td>75%</td>
<td>P = 0.571</td>
</tr>
<tr>
<td>Secondary Tumor</td>
<td>6</td>
<td>12.5%</td>
<td></td>
</tr>
<tr>
<td>Recurrent Pneumonia</td>
<td>5</td>
<td>10.4%</td>
<td>Chi-square test 23.8</td>
</tr>
<tr>
<td>COPD</td>
<td>7</td>
<td>14.6%</td>
<td>P = 0.358</td>
</tr>
<tr>
<td>Other Pulmonary disease</td>
<td>5</td>
<td>10.4%</td>
<td></td>
</tr>
</tbody>
</table>
11. Discussion

In this retrospective evaluation of postoperative course and management we observed a low rate of postoperative complications (12.5%) as compared to 15%-35% in other studies [1]. This low rate can be attributed to the proper preoperative investigation done on each patient. Combined with the individualized postoperative pharmacotherapy and the ability to predict future complications based on preoperative evaluation, and we can modify postoperative care accordingly, as well as standardized guidelines for postoperative care that include: PE prophylaxis, chest physiotherapy, prophylactic antibiotics and pain management. On the other hand, the low rate of complications in our study can be attributed to the relatively small sample size, therefore a higher rate may be observed in a larger study group.

In our study, we did not manage to find any significant correlation between comorbidities of patients and the postoperative course. This can be attributed to proper preoperative investigation and management of these comorbidities by adequate postoperative care. The contradiction with the literature could be due to the small sample size in our study and a large spectrum of comorbidities [1].

As was mentioned above, not all risk factors can be managed postoperatively. This was shown in our study by the 2 patients with complicated courses that were mainly caused by the progressive nature of the underlying disease for which they underwent the surgery in the first place. These are the situations where guideline therapy meets with individualized therapy.

All our patients received postoperative pain management and chest physiotherapy. Unfortunately, the effectiveness of the pain management could not be assessed in this retrospective study but the efficiency of chest physiotherapy is shown by the fact that none of our patient had developed pulmonary embolism, pneumonia, atelectasis or DVT postoperatively. These results are in line with similar investigations done on the efficacy of chest physiotherapy in patient after lung surgery [9] - [12].

The efficiency of chest physiotherapy is increased with the prophylactic administration of broad spectrum antibiotics. All our patients received antibiotic treatment postoperatively; the efficiency of the antibiotic was evaluated by the routine testing of drainage liquids for bacteria and inflammation markers. In most cultures, even with positive culture there was no need for change in antibiotics, and for 40 patients the standard antibiotic therapy was enough. In 7 patients, there was a need to modify antibiotic therapy according to bacterial sensitivity, and in one case we needed to add additional medications. Apart from one patient that developed pleuritis, there was no prolongation of hospital stay due to infection in other patients. When comparing to other studies that investigated the rate of infection in postoperative patients, the infection incidence is similar 5%-24% [26], compared to 20.8% positive
cultures in our study, with 16.7% requirement of modified or additional treatment on top of the standard antibiotics.

One of our patients developed postoperative bleeding that caused a renal failure. This specific patient had a pre-existing condition of renal failure, hence this complication was predicted but this incidence goes to show that even predicted complication with preventive measures cannot be avoided. This patient required excessive renal support but postoperative course of the chest cavity was rather uncomplicated; the patient was moved to nephrology department once chest drainage was removed. The incidence of postoperative bleeding in this study coincides with similar studies 1%-3% [15].

Using routine CXR and chest drainage in our patients we managed to monitor air leaks and stop them. Two patients of the 48 patients developed PAL (4%); when comparing these results to other researches that reported PAL in 8%-26% [18] of their patients. The difference again could be due to sample size, or due to improper documentation as most small air leaks stop on their own. There is a reason to believe that a small air leak that was closed on its own might not have been documented.
12. Conclusions

The complication rate in this study (12.5%) is proven lower than in literature and serves as evidence of an efficient postoperative management by the combined team of specialists. Routine tests and modifications of antibiotic therapy prevented significant complications due to infection in positive culture cases. Early ambulation and chest physiotherapy have prevented DVT and PE complications in all 48 cases. Unfortunately, there will always be unavoidable complications that stem from the progression of the main pathology for which the surgery was indicated.
13. Recommendations

This study was mainly based on the analysis of patients files. The main concern with such analysis is proper documentation of all test results and procedures done. The author of the study reports that most of the data about visitation and follow-up orders and tests, as well as radiologists and physiotherapist consultations, were written by hand, and poorly at that; also, some test results were glued to case files obscuring the writing and were not possible to be removed without damaging the file. This put unnecessary risk of misinterpreting the writing, which may result in an unappropriated test or premature acceleration of procedures in postoperative management, as well as an inconvenient way of conducting retrospective studies. It is recommended to switch to a computerized, printed and documented transcript at the end of each day summarizing all visitations and recommendations by various specialist done during that day; this can be achieved by creating a template transcripts for the various cases of each department. Later this data can be reviewed from hospital computers at any time and location by any attending physician. This will yield a more comfortable work environment that allows proper monitoring and follow-up of patients as they move through departments and retrospective case studies.
14. References


7. Evans RG ,Naidu B. Does a conservative fluid management strategy in the perioperativema


